MODIS
SCIENCE DATA SUPPORT TEAM
PRESENTATION

January 15, 1993

AGENDA

Page

ACTION ITEMS: ACT93_01.15

06/12/92 [Lloyd Carpenter]. Due Date: 02/12/93. Implement Microsoft Project for managing and scheduling MODIS SDST activities, including Level-1A and -1B schedules, Level-2 shell schedule, sizing of computer resource requirements, and overview. STATUS: Open

12/22/92 [Tom Goff]. Due Date: 01/15/93. Determine computer storage and processing requirements for MODIS Level-1A and Level- 1B processing. STATUS: Open.

12/22/92 [Lloyd Carpenter]. Due Date: 03/01/93. Survey the MODIS science team members to determine computer storage and processing requirements for Level-2 processing. STATUS: Open.

12/18/92 [Al Fleig]. Due Date 01/22/93. Meet with John Barker to discuss MCST requirements for Level-1A Earth location processing and data quality classification. STATUS: Open.

12/18/92 [Al Fleig]. Due Date 01/15/93. Discuss requirements for a volcano flag with Peter Mouginis-Mark. STATUS: Open.

MODIS Airborne Simulator (MAS) Status

Liam E. Gumley
Progress up to 14 January 1993

(1) MAS Level-1 processing transition

During the week of 12/28/92 to 12/31/92 I held three interactive sessions with Paul Hubanks and Brenda Colesanti to demonstrate the MAS Level-1 processing sequence. I attempted to cover all aspects of the sequence including:

- loading and reading the Level-0 Exabyte flight tapes,
- organizing the configuration files necessary for processing,
- interactively selecting the straight line flight track start and end times,
- editing the program input files,
- running the calibration and navigation regression programs in the background,
- running the Level-1B production program in the background,
- producing the quicklook imagery and metadata summary,
- storing Level-1B files on tape and copying the quicklook imagery and metadata to the FTP site.

I am now writing up a MAS Level-1 Processing Guide that details all these steps, and includes sample command syntax, program descriptions, glossary of terms, MAS specifications etc. I have already provided copies of "Improved Capabilities of the Multispectral Atmospheric Mapping Sensor" that describes in detail the MAS scanner (common to the MAMS), and the calibration and geolocation procedures that are used.

I have also begun to introduce Paul to the MAS Level-1 source code. So far I have provided him with printouts of the code, and have discussed some aspects of the code operation. I will do some cleaning up and re-organizing over the next few weeks and then deliver a complete copy to him along with instructions on how to compile and run the code on the SGI machine.

(2) MAS Data Users Guide

I am continuing to work on the MAS Data Users Guide, which describes the MAS instrument, the calibration and geolocation procedures, the Level-1B data contents, and instructions on how to use netCDF.

(3) Port of MAS Cloud Optical Depth code from Michael King

To further the development of a MAS Level-2 Processing Prototype, I have taken delivery (on ltpiris2) of an updated version of the Cloud Optical Depth code from Si-Chee Tsay. This version consists of two parts:

1. An updated and cleaned-up main program, which has been modified to read MAS data,

2. A subroutine and function library which is mostly unchanged from previous versions.

Both parts are written in FORTRAN-77 and currently run on the Cray Y-MP. While the main code is commented and structured, the subroutine and function library is less human-readable. The program also requires 9 input files which store lookup table information. At present, these files exist on an IBM mainframe, and are brought to the Cray using a custom 'fetch' command on the Cray which performs the necessary translations between IBM and Cray binary data representations. Rather than attempting to port these files to ltpiris2 (which caused many problems previously), it was decided to resurrect the code which generated the lookup table files, and port it to the SGI machine. Tom Arnold is currently reviving the code on the IBM.

MODIS Level-2 Processing Shell Design and Development

J. J. Pan
MODIS Science Data Support Team
(301) 982-3700

Date: December 21, 1992 - January 14, 1993

1. Algorithm Dependency Diagram and Data Products

As suggested by Al Fleig, a table of MODIS Level-2, -3, and -4 data products is updated. In this table, in additional to the product number, product name, and the corresponding investigator(s), four additional columns are appended. The *HQ* column indicates that the product is selected at-launch, selected post-launch, or not selected by NASA headquarters. The *Team* column indicates whether the product is desired at-launch or desired post-launch by the team member. The *Problem* column indicates any conflicts between *HQ* and *Team*. The *priority* of each product will be assigned by each discipline leader. On the basis of this table, the algorithm dependency diagram (Version 5.0) is updated again. Compared with earlier versions, there have been a few changes in the notation used in the diagram. If there is a difference between *HQ* and *Team* listings, then the product is put in a small box.

A new table is also prepared indicating which channels will be used for each product. The information is obtained from the following references :

1. The Science Processing Database (SPDB) from the Science Processing Support Office (SPSO), Goddard Space Flight Center.
2. M. D. King, Y. J. Kaufman, W. P. Menzel, and D. Tanre, 1992, Remote Sensing of Cloud, Aerosol, and Water Vapor Properties from the MODIS, IEEE Trans. Geoscience and Remote Sensing, V. 30, No. 1, p.2-27.
3. P. E. Ardanuy, D. Han, and V. Salomonson, 1991, The MODIS Science and Data System Requirements, IEEE Trans. Geoscience and Remote Sensing, V. 29, No. 1, p.75-88.

A package that includes these two tables and one diagram has been sent to each team member. We expect to receive comments and corrections from team members before January 15.

MODIS Level-1A, -1B, -2 Data Products (for all groups)

Product #	Product Name	Investigator(s)	HQ	Team	Problem	Priority
1001	Level-1A Radiance		A	A		
2338	Level-1B Radiance	Salomonson	A	A		
3660	Classification Masks, Clouds/Snow/Land/Water, MODIS Level-2	Salomonson Barker (with Hall)	N	A	!	

MODIS Level-2 Data Products (Land Group)

Product #	Product Name	Investigator(s)	HQ	Team	Problem	Priority
2015	Spectral Reflectance/Surface Leaving Radiance	Kaufman, Tanre, Strahler, Muller	A	A		
2047	Soil Index	Huete	N	A	!	
2266	PAR,Sfc (IPAR) and Incident (IPAR)	Carder. Tanre	A	A		
2404	Land_sfc Radiance-Correction, Topographic	Muller	A	A		
2484	Land_sfc Temperature	Wan	A	A		
2749	Vegetation Index	Justice, Huete et al	A	A		
3020	Snow Cover	Salomonson, Hall	A	A		
3323	Land_sfc Emissivity	Wan	N	P	!	
3669	Bidirectional Reflectance/Spectral Albedo	Muller, Strahler, Tanre	P	A	?	
3670	Land_sfc Roughness	Muller	N	P	!	

Note:
1. In the HQ (Headquarters) column, A = Selected At-Launch, P = Selected Post-Launch, N = Not Selected. In the Team column, A = Desired at Launch, P = Desired at Post-Launch.
2. Product 2015 (Spectral Reflectance/Surface Leaving Radiance) is listed in both Atmosphere and Land groups.
3. Product 2266 (Sfc IPAR and Incident IPAR) is listed in both Land and Ocean groups.
4. Algorithms for products 2330 (PAR) and 4001 (Normalized Clear Water) are to be determined in the ocean group.
5. The diagram is based on the Team Memember's suggestions.
6. STIKSCAT is being dropped. ALT is proposed for launch in 2003. AIRS is on the PM platform. ASTER will take only regional data.
7. Discipline Leaders will assign the priority of data products.

MODIS Level-2 Data Products (Ocean Group)

Product #	Product Name	Investigator(s)	HQ	Team	Problem	Priority
A	Calibration Data	Evans	N	A	!	
1688	Wind Velocity, Sea_sfc Glint-Pattern	Gordon	N	P	!	
2031	Ocean Water Attenuation Coef, PAR	Clark, Gordon	N	A	!	
2254	Glint Field	Gordon	N	P	!	
2266	PAR,Sfc (IPAR) and Incident (IPAR)	Carder, Tanre	A	A		
2295	Aerosol Angstrom Exponent	Gordon	N	A	!	
2330	PAR	Esaias	N	P	!	
2344	Aerosol Radiance	Gordon	N	A	!	
2416	Level-2 Radiance, Water-leaving	Gordon et al	A	A		
2527	Sea_sfc Temperature (SST)	Brown, Barton	A	A		
2555	Phytoplankton Backscatter Coef	Gordon, Clark	N	P	!	
2559	Ocean Water Backscatter Coef, Total	Gordon, Parslow	N	A	!	
2566	Chlorophyll_a Conc (via Fluorescence)	Abbott	N	P	!	
2569	Case II Waters Chlorophyll_a Conc	Carder	A	A		
2571	Chlorophyll_a Pigment Conc	Clark	A	A		
2573	Chlorophyll Fluorescence Line Curv	Hoge	N	A	!	
2575	Chlorophyll Fluorescence Line Height	Abbott, Evans	A	A		
2577	Coccolith Conc, Detached	Gordon, Clark	N	P	!	
2580	Organic Matter Conc, Dissolved	Carder	P	A	?	
2582	Organic Matter Conc, Dissolved	Gordon, Parslow	A	A		
2591	Pigment Conc	Gordon, Clark	N	A	!	
2593	Pigment Conc (via Spectral Curv)	Hoge, Esaias	N	P	!	
2602	Ocean Productivity, Primary, Near_sfc (via Fluorescence)	Abbott	P	P		
2608	Organic Matter Conc, Particulate	Clark	N	P	!	
3085	Suspended-Solids Conc, Ocean Water	Clark	N	A	!	
3153	Sea_Ice Max Extent	Salomonson	A	A		
3199	Ocean Water Attenuation Coef@490nm	Gordon, Clark	N	A	!	
3206	Ocean Water Attenuation Coef@520nm, Beam	Clark, Gordon	N	A	!	
3211	Chlorophyll Fluorescence Efficiency	Abbott	N	P	!	
3216	Particulate Backscatter Coef	Gordon, Parslow	N	A	!	
3662	Organic Matter Degradation_Product Absorption Coef@415nm (DOM+Detritus)	Carder	N	A	!	
4001	Normalized Clear Water	Carder	N	A	!	
4002	Clear Water Epsilon	Carder	N	A	!	

MODIS Level-2 Data Products (Atmosphere Group)

Product #	Product Name	Investigator(s)	HQ	Team	Problem	Priority
1017	Aerosol Mass Loading	Kaufman	N	P	!	
1022	Aerosol Size-Distribution (Radius-Dispersion)	Tanre, King	A	A		
1333	O_3 Total Burden	Menzel	N	A	!	
1528	Cloud Top Properties	Menzel	A	A		
1559	Stability (Lifted Index), Atmospheric	Menzel	N	A	!	
1764	Cloud Drop Phase	King, Menzel	A	A		
1780	Cloud Drop Size (Effective Radius)	King	A	A		
1874	Precipitable Water	Kaufman, Tanre, Menzel	N	A	!	
2003	Albedo, Aerosol	Tanre, Kaufman	N	P	!	
2015	Spectral Reflectance/Surface Leaving Radiance	Kaufman, Tanre, Strahler, Muller	A	A		
2081	Cloud Cover	King, Kaufman	A	A		
2293	Aerosol Optical Depth, Spectral	Kaufman, Tanre	A	A		
2311	Cloud Optical Depth	King	A	A		
2471	Thermal Anomalies	Kaufman	N	A	!	

MODIS Level-3 Data Products

Product #	Product Name	Investigator(s)	HQ	Team	Problem	Priority
2068	Cloud Field Area	Kaufman	N	P	!	
2094	Cloud JPDF	King, Menzel	N	P	!	
2337	Vegetation Index, Polarization	Vanderbilt	N	P	!	
2606	Ocean Productivity, Primary	Esaias	A	A		
2669	Land_Cover Type	Strahler, Huete et al.	N	A	!	
2671	Land_Cover Type-Change	Strahler, Huete et al.	N	A	!	
3696	Land_sfc BRDF, AM-PM Asymmetry	Vanderbilt	N	P	!	

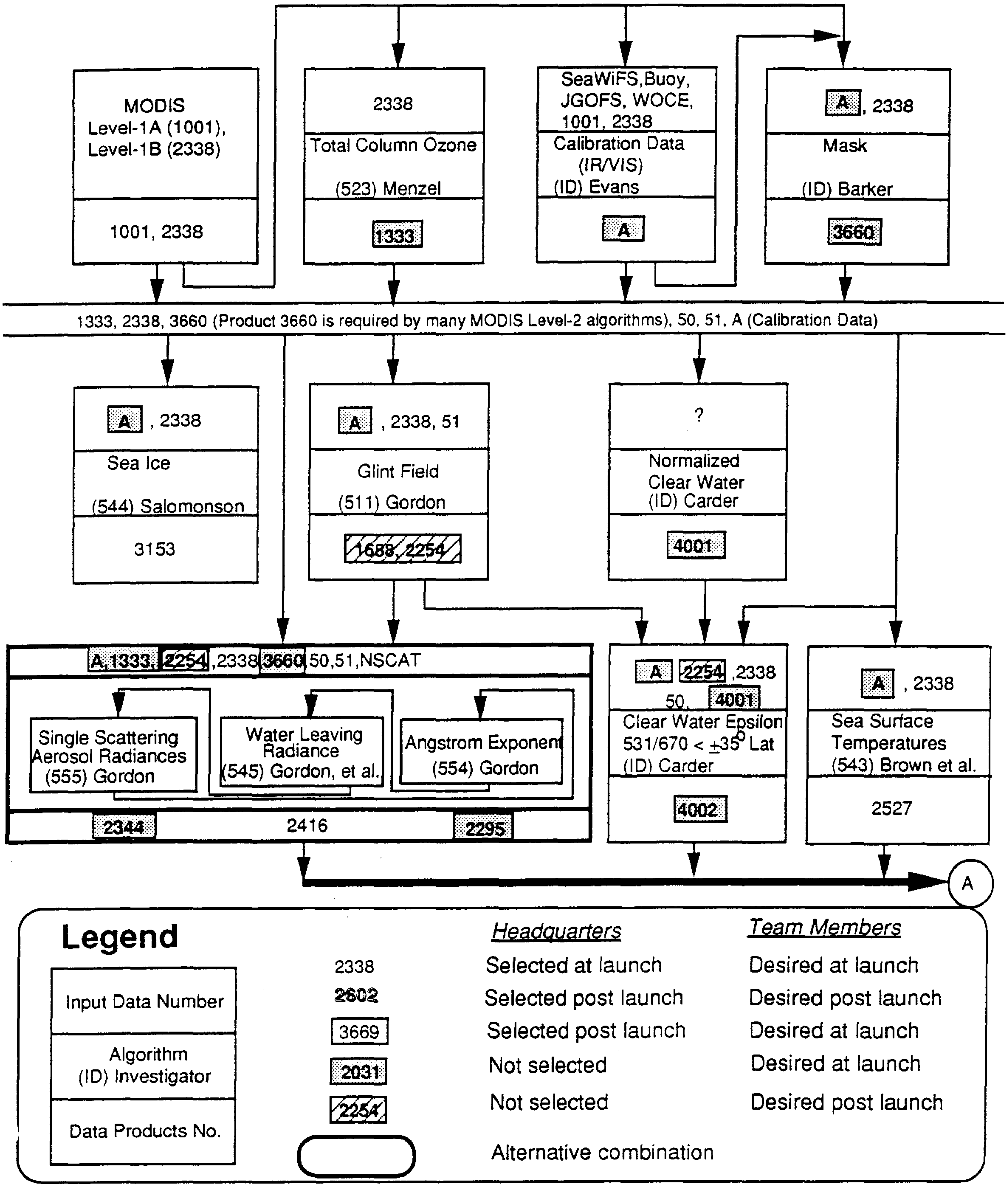
MODIS Level-4 Data Products

Product #	Product Name	Investigator(s)	HQ	Team	Problem	Priority
2680	Vegatation Index, Leaf Area, (LAI)	Running	N	P	!	

Level-2 Input Data from Non-MODIS Instruments

Product #	Product Name	Time Frame	Selected or Nonselected	Instrument
	SeaWiFS. Buoy. JGOFS. WOCE. NSCAT. ECMWF			
50	Surface Air Pressure	BL, PL		
51	Surface Wind Speed: In Situ	PL		
184	Radiation Budget Components in Snow			
186	Directional radiance. Spectral Irradiance			
197	Ground Data			
199	BRDFs			
200	Climate Data	AL, PL		
202	Ground Radiances	BL, AL		
203	Ground Radiances		Nonselected	MIMR
753	Biome Discrimination			
847	Digital Elevation Model: DTED-1. DCW	AL		
1735	Wind Speed, Along-Track	AL	Nonselected	ALT
1828	Humidity Profile	AL	Selected	AIRS
2335	Aerosol Phase Function. Asymmetric	PL	Selected	MISR
2828	Topographic Elevation. Land sfc (DEM)	AL	Selected	ASTER
2846	Topographic Elevation, Land sfc	PL	Selected	MISR
3594	Wind Stress. Sea sfc	AL	Selected	MIMR
7001	Level-1B Radiance. POLDER			POLDER
7002	Level-1B Polarization. POLDER			POLDER

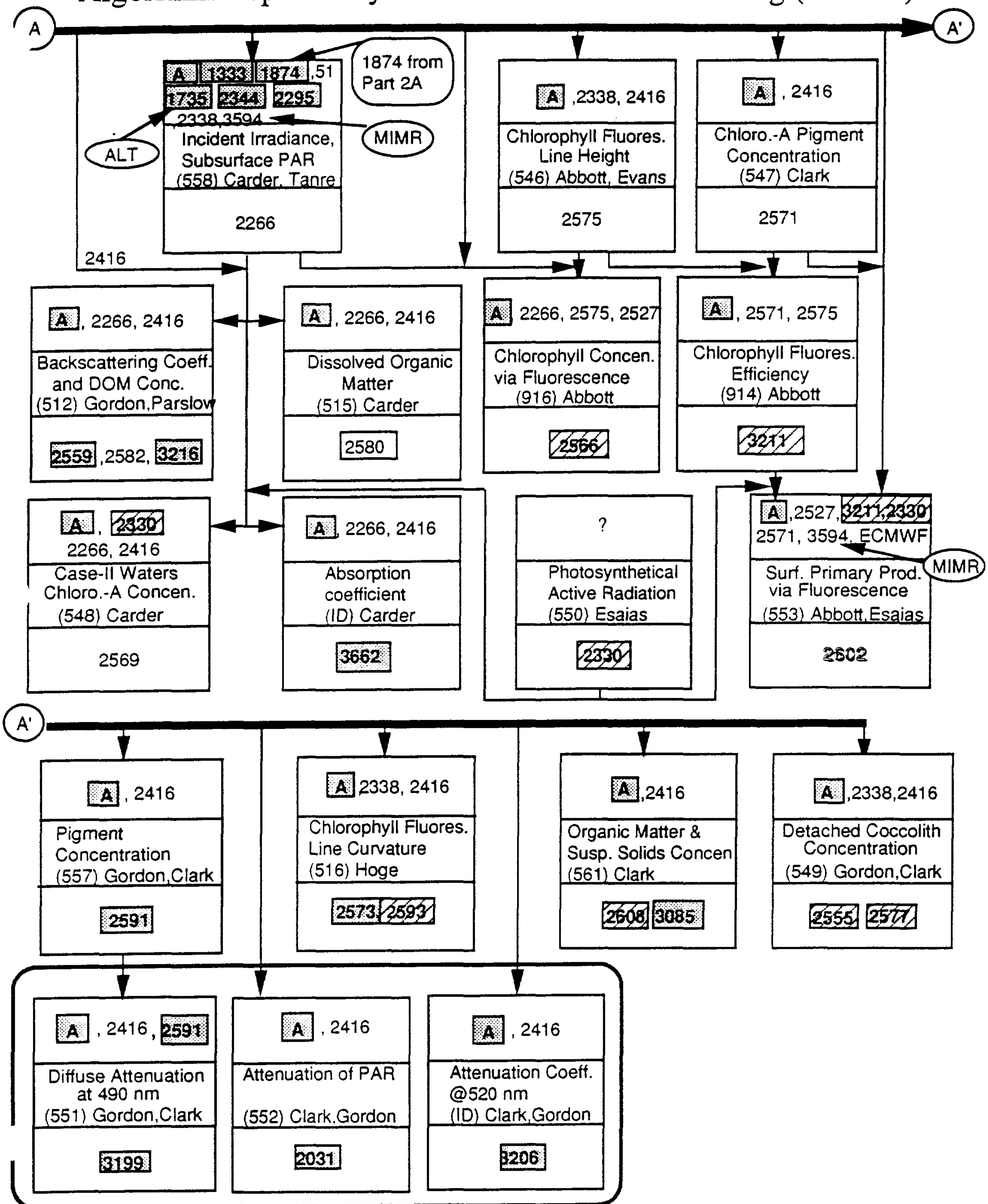
DRAFT (Ver. 5.0)
Algorithm Dependency in MODIS Level-2 Processing (Part 1A)



MODIS/SDST/RDC/J.J.Pan

January 6, 1993/Version 5.0

DRAFT (Ver. 5.0)
Algorithm Dependency in MODIS Level-2 Processing (Part 1B)

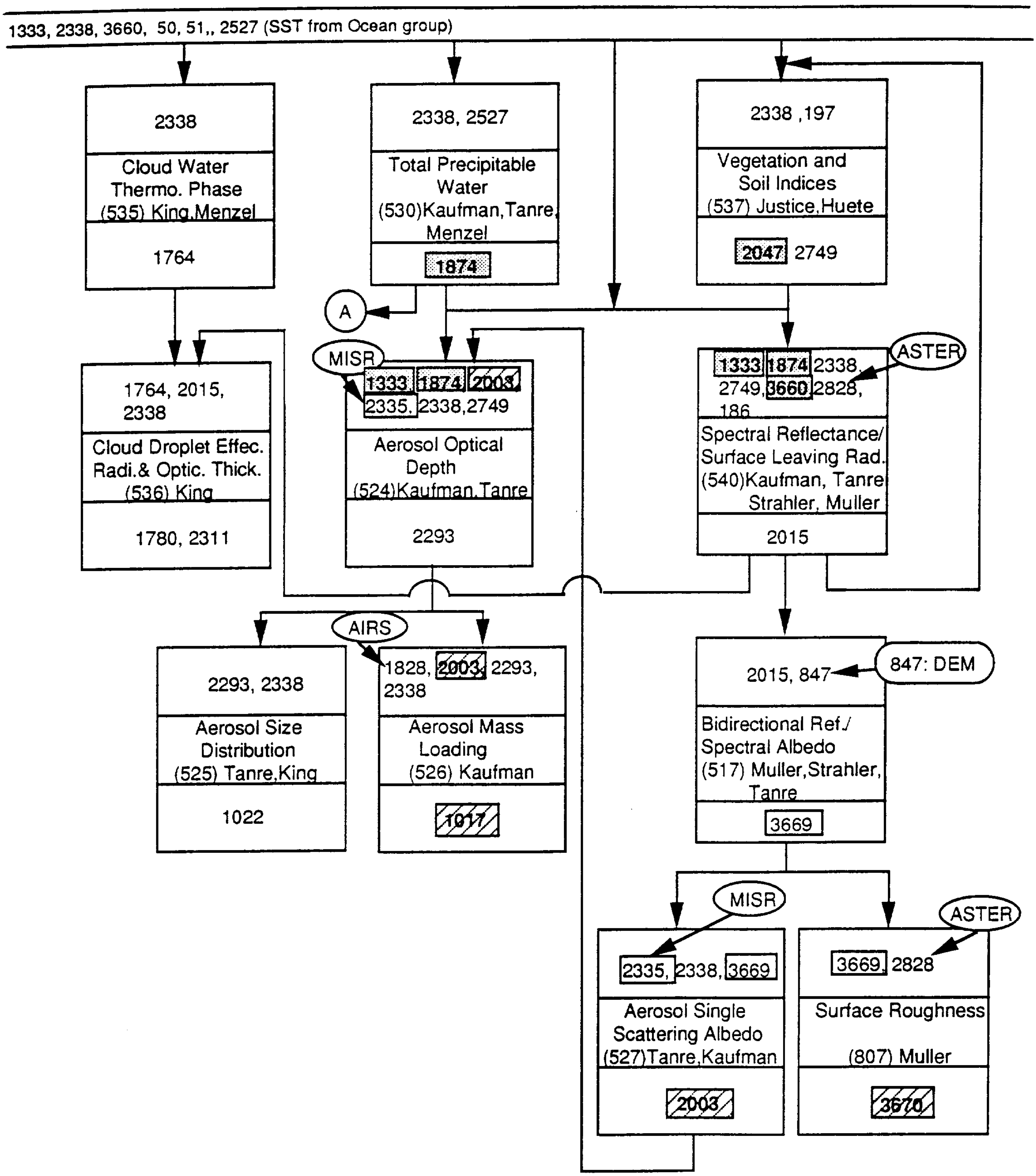


MODIS/SDST/RDC/J.J.Pan

January 6, 1993/Version 5.0

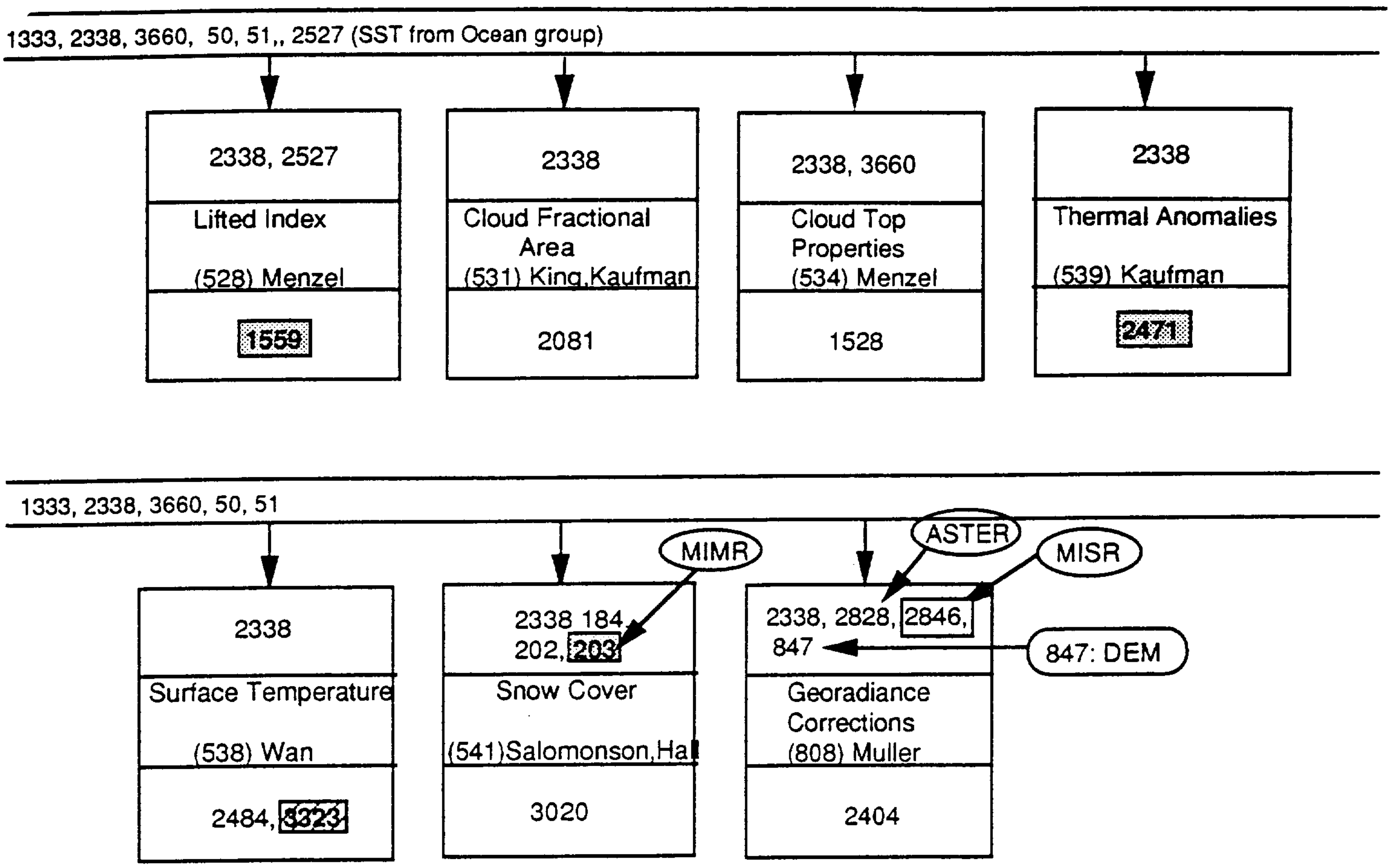
DRAFT (Ver. 5.0)

Algorithm Dependency in MODIS Level-2 Processing (Part 2A)

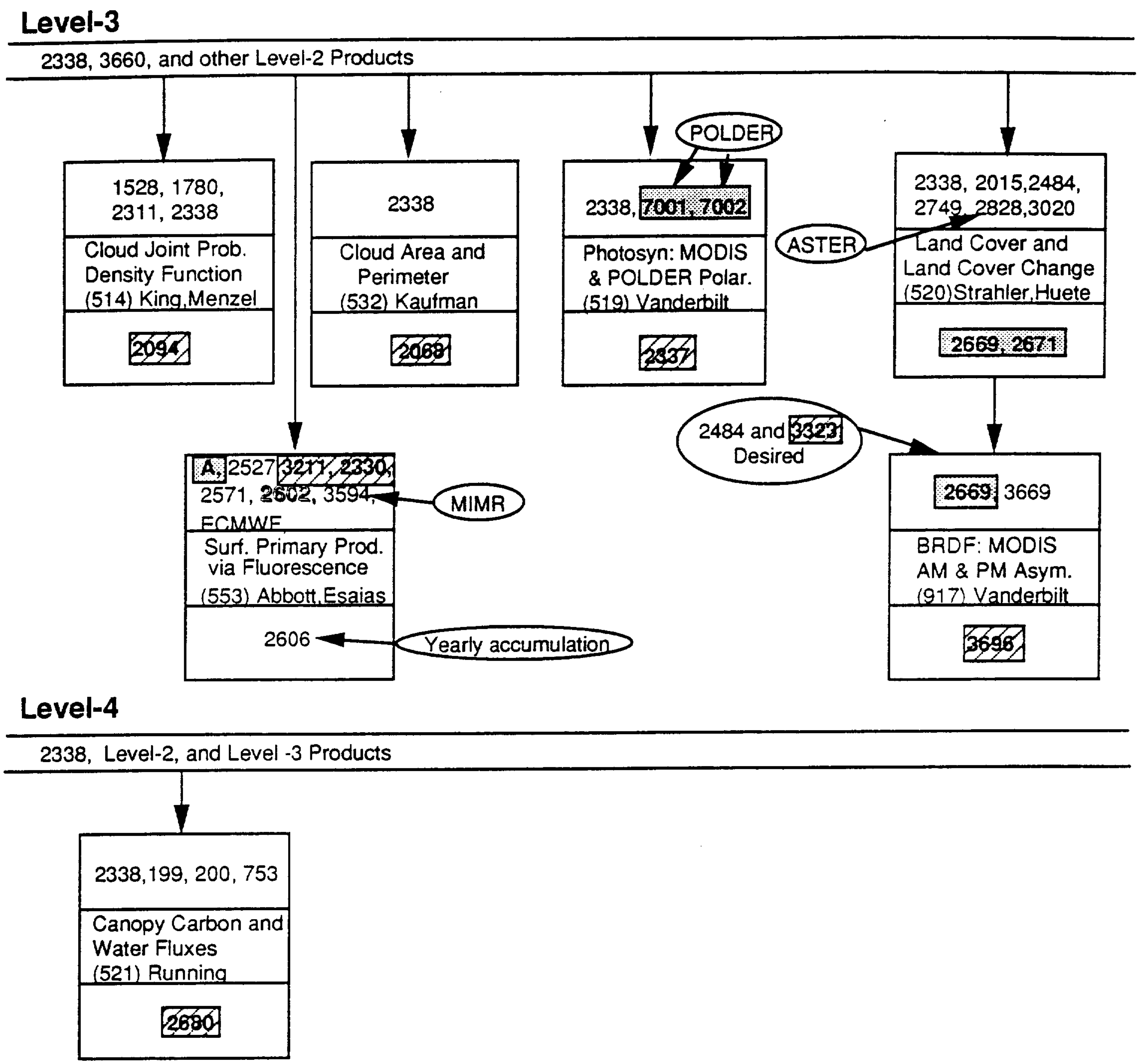


DRAFT (Ver. 5.0)

Algorithm Dependency in MODIS Level-2 Processing (Part 2B)



DRAFT (Ver. 5.0)
Algorithm Dependency in MODIS Level-3 and -4 Processing



MODIS Algorithms and Required Channels

			Channel																			
Algo. ID	Algorithm Name	Investigator(s)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
546	Chlorophyll Fluorescence Line Height	Abbott, Evans													x	x	x					
553	Surface Primary Productivity via Fluor.	Abbott, Esaias								x	x	x	x	x	x	x	x	x				
914	Chlorophyll Fluorescence Efficiency	Abbott								x	x	x	x	x	x	x	x	x				
916	Chlorophyll Concentration via Fluor.	Abbott								x	x	x	x	x	x	x	x	x				
	Mask	Barker																				
543	Sea Surface Temperatures	Brown et al.																				x
	Normalized Clear Water	Carder																				
	Clear Water Epsilon 531/670 < ±35° Lat.	Carder																				
	Absorption Coeff.	Carder								x	x	x	x	x	x	x	x	x				
515	Dissolved Organic Matter	Carder								x	x	x	x	x	x	x	x	x				
548	Case-II Water Chlorophyll-A Concen.	Carder								x	x	x	x	x	x	x	x	x				
	Attenuation Coeff. @520nm	Clark, Gordon								x	x	x	x	x	x	x	x	x				
547	Chlorophyll-A Pigment Concentration	Clark								x	x	x	x	x	x	x	x	x				
552	Attenuation of PAR	Clark, Gordon								x	x	x	x	x	x	x	x	x				
561	Organic Matter and Suspended Solids Concen.	Clark								x	x	x	x	x	x	x	x	x				
550	Photosynthetically Active Radiation	Esaias								x	x	x	x	x	x	x	x	x				
	Calibration Data (IR/VIS)	Evans																				
511	Glint Field	Gordon								x	x	x	x	x	x	x	x	x				
512	Backscattering Coefficients and DOM Conc.	Gordon, Parslow								x	x	x	x	x	x	x	x	x				
549	Detached Coccolith Concentration	Gordon, Clark								x	x	x	x	x	x	x	x	x				
551	Diffuse Attenuation at 490 nm	Gordon, Clark																				
554	Angstrom Exponent	Gordon								x	x	x	x	x	x	x	x	x				
555	Single Scattering Aerosol Radiances	Gordon																				
557	Pigment Concentration	Gordon, Clark								x	x	x	x	x	x	x	x	x				
558	Incident Irradiance, Subsurface PAR	Gordon, Tanre								x	x	x	x	x	x	x	x	x				
545	Water Leaving Radiance	Gordon et al.								x	x	x	x	x	x	x	x	x				
516	Chlorophyll Fluorescence Line Curvature	Hoge								x	x	x	x	x	x	x	x	x				
537	Vegetation and Soil Indices	Justice, Huete	x						x													
524	Aerosol Optical Depth	Kaufman, Tanre	x	x	x	x	x	x	x	x												
526	Aerosol Mass Loading	Kaufman			x																	

530	Total Precipitable Water	Kaufman, Tanre, Menzel		x															x	x	x	
532	Cloud Area and Perimeter	Kaufman	x	x																		
539	Thermal Anomalies	Kaufman																				x
540	Spectral Reflectance/Surface Leaving Radiance	Kaufman,Tanre, Strahler, Muller	x	x	x	x	x	x	x	x												
514	Cloud Joint Probability Density Function	King, Menzel																				
531	Cloud Fractional Area	King, Kaufman	x					x														x
535	Cloud Water Thermodynamic Phase	King, Menzel	x					x	x													
536	Cloud Droplet Effective Radius and Optical Thickness	King	x						x													x
523	Total Column Ozone	Menzel																				
528	Lifted Index	Menzel																				
534	Cloud Top Properties	Menzel																				
517	Bidirectional Reflectance/Spectral Albedo	Muller, Strahler, Tanre	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
807	Surface Roughness	Muller																				x
808	Georadiance Corrections	Muller																				x
521	Canopy Carbon and Water Fluxes	Running																				
541	Snow Cover	Salomonson, Hall																				
544	Sea Ice	Salomonson																				
520	Land Cover and Land Cover Change	Strahler, Huete																				
525	Aerosol Size Distribution	Tanre, King	x	x	x	x	x	x	x	x												
527	Aerosol Single Scattering Albedo	Tanre, Kaufman	x	x																		
519	Photosynthesis: MODIS and POLDER Polar.	Vanderbilt																				
917	BRDF: MODIS AM and PM Asymmetry	Vanderbilt	x	x						x	x	x	x	x	x	x	x	x	x	x	x	x
538	Surface Temperature	Wan																				x

MODIS Algorithms and Required Channels

Algo. ID	Algorithm Name	Investigator(s)	Channel															
			21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
546	Chlorophyll Fluorescence Line Height	Abbott, Evans																
553	Surface Primary Productivity via Fluor.	Abbott, Esaias																
914	Chlorophyll Fluorescence Efficiency	Abbott																
916	Chlorophyll Concentration via Fluor.	Abbott																
	Mask	Barker																
543	Sea Surface Temperatures	Brown et al.		x	x								x	x				
	Normalized Clear Water	Carder																
	Clear Water Epsilon 531/670 < ±35° Lat.	Carder																
	Absorption Coeff.	Carder																
515	Dissolved Organic Matter	Carder																
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516	Chlorophyll Fluorescence Line Curvature	Hoge																
537	Vegetation and Soil Indices	Justice, Huete																
524	Aerosol Optical Depth	Kaufman, Tanre																
526	Aerosol Mass Loading	Kaufman																

530	Total Precipitable Water	Kaufman, Tanre, Menzel		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
532	Cloud Area and Perimeter	Kaufman																
539	Thermal Anomalies	Kaufman	x															
540	Spectral Reflectance/Surface Leaving Radiance	Kaufman,Tanre, Strahler, Muller																
514	Cloud Joint Probability Density Function	King, Menzel																
531	Cloud Fractional Area	King, Kaufman									x			x				
535	Cloud Water Thermodynamic Phase	King, Menzel												x				
536	Cloud Droplet Effective Radius and Optical Thickness	King											x	x				
523	Total Column Ozone	Menzel										x						
528	Lifted Index	Menzel		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
534	Cloud Top Properties	Menzel												x	x	x	x	x
517	Bidirectional Reflectance/Spectral Albedo	Muller, Strahler, Tanre																
807	Surface Roughness	Muller	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
808	Georadiance Corrections	Muller	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
521	Canopy Carbon and Water Fluxes	Running																
541	Snow Cover	Salomonson, Hall																
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527	Aerosol Single Scattering Albedo	Tanre, Kaufman																
519	Photosynthesis: MODIS and POLDER Polar.	Vanderbilt																
917	BRDF: MODIS AM and PM Asymmetry	Vanderbilt	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
538	Surface Temperature	Wan	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

MODIS Earth Location Status

1. The "Analysis of MODIS Earth Location Error" report is nearing completion. The purpose of this report is to describe the Earth location (or geolocation) errors of MODIS pixel data resulting from errors in the knowledge of:

- EOS AM Platform position in space
- EOS AM Platform pointing
- MODIS Instrument pointing

Earth location error summary information is divided into 3 Platform/Instrument design scenarios:

- Platform/Instrument built to meet, but not exceed, the specification ("Spec" design)
- Platform/Instrument built to meet current contractor estimate ("Likely Built" design)
- Platform/Instrument built to meet current contractor estimate, with additional ground processing that successfully removes estimated static error components. ("Likely Built with estimated static error removed" design).

Equations and methods used for these calculations are also included.

I received updated pointing error estimate budgets from SBRC (MODIS Instrument) and GE (EOS AM Platform) on Tuesday. The new Platform pointing budget showed a slight decrease in static error components, a slight increase in dynamic error components, and total combined error approximately 2% less than previously noted. The new Instrument pointing budget showed a slight decrease in both static and dynamic error components, and total combined error approximately 8% less than previously noted. I am in the process of updating tables and plots to reflect these new estimates.

Even though the pointing and position budgets customarily present 3-Sigma errors, all tables and plots in this report relating to Earth location will present resultant 2-Sigma errors. For an assumed Gaussian (normal) distribution of error, 3-Sigma errors incorporate 99.7% of the data, 2-Sigma errors incorporate 95.5% of the data, and 1-Sigma errors incorporate 68.3% of the data.

MAS Concepts, Processing, and Software Familiarization

Due to Liam Gumley's upcoming departure from the MODIS SDST, I have been assigned the task to oversee MAS processing and software maintenance.

1. I have begun to familiarize myself with the MAS processing concepts and software. Liam gave me a complete printout of the Fortran code used for MAS processing on January 4th and we met on January 6th for a software overview presentation. I have also begun to read the NASA Tech Memo: "Improved Capabilities of the Multispectral Atmospheric Mapping Sensor (MAMS)" which reviews characteristics, calibration, and geolocation used in MAMS (and hence MAS, since they share the same scanner).

2. Liam Gumley ran a MAS ASTEX processing demo on December 29th, 30th, and 31st for Brenda Colesanti and me on the LTP/INDIGO workstation. Several straight-line flight tracks, for a single day in the experiment, were identified and processed. Brenda and I will begin the effort of reprocessing ASTEX data (using the final calibration coefficients) after Liam completes the MAS Processing Guide within the next week.

Assumptions / Tracking / Risk List

for

The MODIS Level-1A and 1B Data Product Generator Design

Thomas E. Goff
MODIS Science Data Support Team
7 January 1993

This document contains a list of items that have been assumed in the derivation of the MODIS Level-1A and 1B preliminary design. It also includes those items that need to be tracked as part of the overall MODIS Science Data Support Team (SDST) effort and those items that present a risk to the successful completion of this design effort. Items that are included for tracking will be resolved in the future and contain the descriptions (where possible) of the parties responsible for the missing information. Items that are assumptions have been included in the current concept of the design but may be modified in future revisions of the design as it becomes further refined and implemented. This list is a component to the design of the MODIS Level-1A and 1B processes. The companion assumptions / tracking / risk lists for the other processors should also be consulted for completeness.

Data Product Data Types. The Level-1A data product will be in organized into integer data type arrays. The Level-1B data product will be organized into real number (floating point) arrays.

Level-1A produces only an organized, byte aligned, unpacked science data product. The Level-1B process applies an instrument radiance calibration which will be in floating point form.

Ground Navigation

Instrument Position and Attitude. Definitive Spacecraft position and attitude will be available to the MODIS processors coincident with the MODIS instrument data.

It is assumed that the best available spacecraft position and attitude information will be available to the MODIS Level-1A and Level-1B data product generators at the same time that the MODIS Level-0 data is available. MODIS instrument to platform translations will also be known at processing time. Further navigation accuracy may be obtained utilizing post processing techniques such as ground control point registration. This may result in improved ground location accuracy which will be appended to the original data set in a succeeding processing step and possibly used to update the instrument to platform offsets. Spacecraft position and attitude are not expected to be improved beyond the accuracy obtained during the initial processing.

Level-1A Anchor Points. Selected pixels, not the entire scan, will be navigated to Earth ground locations in the Level-1A processing.

A scanwise nonlinear set of ground based (anchor) points has been selected to represent the Earth locations of pixels within a MODIS Data Product. A report illustrating the accuracies and scanwise placements of these anchor points has been published by the MODIS Science Data Support Team. The ground locations of the selected pixels are determined solely from the satellite position, attitude, and instrument geometry without the use of ground control points. The location of these ground points will be provided by a PGS Tool kit function which accepts the instrument pointing vector and returns the WGS84 ground position.

Anchor Point Coordinate System. Selected Earth location points, represented in the geodetic Latitude Longitude coordinate system, will be included in the Level-1A data set.

Coordinate transformations from the EOS platform coordinate system to the instrument will be performed by the MODIS processors using standardized transformation routines. Latitude and longitude will be in the geodetic rather than the geocentric coordinate system. A standardized PGS tool kit function will be utilized to supply this location.

Earth Model. The Earth location anchor points will be represented in the WGS84 1984 oblate spheroid (rotated ellipsoid) representation.

Anchor Point Parameters. At the selected ground anchor points, the following parameters will be provided in the Level-1A data product: Earth position in Latitude / Longitude, satellite zenith and azimuth angles, solar zenith and azimuth angles, and optional satellite slant range or instrument position and attitude.

Other needed parameters such as solar to spacecraft relative azimuth and zenith angles can be easily calculated from these appended parameters. The slant range or instrument position and attitude would be required for Level-1B processing if a DTM correction is to be handled by the MODIS processor. (Slant range facilitates the computation of any digital elevation model (DEM) corrections in later processes without referencing additional information which would cause configuration management problems associated with a dynamic database.) Note that slant range will not be necessary if a PGS tool kit function incorporating terrain height is available. Spacecraft position as a function on time is assumed to be a PGS tool kit function.

Level-1B Elevation Correction. A terrain elevation correction for all pixel positions will be included in the Level-1B.

The correction for terrain elevation will be included in the Level-1B data product. An Earth geoid based elevation data set is proposed to be included with an implementation of a digital terrain model (DTM) and will be performed at all pixels, not just the anchor point pixels. This location function will be performed by the PGS tool kit.

Atmospheric Correction. Atmospheric correction will not be performed in the MODIS level-1B process.

Bending of the scan vector due to atmospheric refraction has been shown to be negligible.

Level-1A Point Flags. Cloud, land / ocean, or other derived flags will not be included in the Level-1A data products.

These flags are best applied to every pixel in the Level-1B data product. An indication of the percentage of ocean, land, or cloud cover may be included in the future for metadata purposes in Level-1B.

Anchor Point Error Statistics. No statistical measure of anchor point accuracies will be included in the Level-1A data product.

An indication of the anchor point statistical accuracies can be derived externally in a non time critical environment and is not unique to an individual data product. Accuracies are to be derived from platform knowledge parameters initially and verified via off-line methods to be available after the MODIS data have been published. Corrections based on post processing position determination will be included as appended data elements to the data product in a post processing step.

Level-1B Calibration Techniques. Processing requirements for the calibration of the MODIS data to be included in the Level-1B Data Product are currently unknown.

The Level-1B design effort is highly dependent on the form and techniques to be used in the calibration of the MODIS data. At the current depth (structured decomposition) of the Level-1B processor design, the calibration is assumed to be a function (subroutine) to be specified and possibly written by the MCST. If the scope of the calibration needs data, or uses techniques that can not be accommodated by a function call, then the Level-1B process will need to be redesigned.

Browse Requirements. Neither the Level-1A nor the Level-1B process generate a browse product.

Any required browse products will be generated by a separate process in order to take full advantage of future technologies without compromising the main data product processing. This allows technologies such as those currently in development for high definition television (HDTV), windowed graphical user interface (GUI) laser based video, or similar approaches to be used as they are developed without compromising the Level-1B product generation process. This also allows for the concept of 'on the fly' browse to be implemented. *Browse generation is assumed to be a DADS function, not a MODIS function.*

Required Ancillary Data. No ancillary data (in-situ) will be required for the MODIS Level-1A or Level-1B processing.

Calibration methodologies have not be determined at present, but are currently assumed to not require in-situ ground based data. Ground location which can be used to extract in-situ raw MODIS instrument measurements is included in both the Level-1A and Level-1B data products.

MODIS Configuration Management. Calibration algorithm or coefficient changes will force a revision to the MODIS processing program.

Configuration management will be applied to the MODIS programs and will control any change in methodology to a configured process. A full validation will be performed even if calibration coefficients have been altered. This applies to all embedded constants such as the instrument to platform offsets. Ancillary data are not under configuration control but will include revision codes and be a part of every data product that is produced.

Quality Assurance Checks. Formal quality control determination will not be performed by the MODIS Level-1A or Level-1B processes, other than the detection of problems which will compromise the integrity of the Level-1A or Level-1B processing.

Specific requirements for items that may be included in any future quality assurance or data quality checks have not been identified at the present time. Quality checks may be included in later design revisions when specified. This discussion of the 'formal' Quality Assurance applies to the known requirements at the time this document was written. A provision for a quality / completeness indication for each scan cube is included in the current design and can be used for 'formal' quality if desired.

Anomaly Detection. The MODIS Level-1B process will post problem and anomaly reports only to the MODIS data product log.

This log will be accessible to other processes on a read-only basis to allow problem and event anomalies to be tracked. Any requirements to alert other processes (such as the MODIS Characterization Support Team or other instrument product generators) of anomaly occurrences have not been determined at this time.

Instrument Command Comparison. The MODIS Level-1B process will not check instrument states with respect to the Instrument Command and Control (ICC) processes.

The ICC log will not be available for examination until 48 hours after items have been posted to the log. This time constraint does not allow the MODIS process to compare telemetered data with commanded states. Problems or anomalies detected in the telemetered data stream will be posted to the MODIS data product log and made available to other processes as necessary.

Engineering Data. Non science data will be byte aligned to integer data types only.

The Level-1A data product generator will organize the engineering data (housekeeping, solar diffuser, SRCA, black body, mirror linearity, decommutated status, etc.) into an appropriate data structure. Conversion of raw thermistor data values to temperatures, for example, is not currently planned to be a part of the Level-1A or Level-1B processing. Any inclusion of these requirements needs to be specified at a later date.

Data Compression. No data compression will be performed within the MODIS Level-1A or Level-1B processes.

Data compression is best performed either in hardware or in software during the transfer of data to and from the mass storage archiving devices. Note that hardware compression techniques can be emulated in software that can be distributed as auxiliary processes or subroutines to outside (of EOSDIS) organizations.

Context-Diagram
MODIS Level-1A